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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/721,932	11/25/2003	K.R. Udayakumar	TI 35507	8320
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TEXAS INSTRUMENTS INCORPORATED P O BOX 655474, M/S 3999 DALLAS, TX 75265			EXAMINER VINH, LAN	
			ART UNIT	PAPER NUMBER

1765  
DATE MAILED: 11/24/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/721,932

Applicant(s)

UDAYAKUMAR ET AL.

Examiner

Lan Vinh

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 20 September 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) 22-25 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-5, 7-15 and 17-21 is/are rejected.
- 7) ☒ Claim(s) 6 and 16 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Response to Arguments presented in the Appeal Brief filed on 9/20/2006***

1. Applicant's arguments in response to the final rejection(s) of claims 1-4, 8-10, 11-14 as being unpatentable over Yang in view of Song and further in view of Tomioka, see pages 8-10 of the Appeal Brief, which argue that none of the references acknowledge the benefits of using the aluminum oxide etch stop layer as an etch stop layer, in conjunction with the acknowledgement of the benefits of using an etchant that uses a flow rate of carbon oxide greater than about 80 sccm have been fully considered and are persuasive. The previous final rejection(s) of claims 1-5, 7-15, 17-21 have been withdrawn. However, upon further consideration, a new ground of rejection of claims 1-4, 11-14, 20 under U.S.C 103(a) over Yang and newly cited references of Kim et al (US 6,500,763) which teaches the benefits of using the aluminum oxide etch stop layer and Kim et al (US 6,686,293) which discusses the benefits of using an etchant that uses a flow rate of carbon oxide greater than about 80 sccm is discussed below

### ***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4, 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yang et al (US 6,162,583) in view of Kim et al (US 6,500,763) and further in view of

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Kim et al (US 6,686,293)

Yang discloses a method for making intermetal dielectric on semiconductor device.

The method comprises the steps of:

providing a substrate 20 having an etch stop layer 18 (SiN) located thereunder (col 5, lines 55-65; fig. 6)

etching an opening in the substrate using an etchant comprising a carbon oxide, CF<sub>4</sub>/fluorocarbon, oxygen/an etch rate modulator and an inert carrier gas (col 4, lines 4-10), the etchant does not etch layer 18 (fig. 6), which reads on the etchant is selective to the layer 18/etch stop layer

Unlike the instant claimed invention as per claim 1, Yang fails to expressly disclose using an aluminum oxide etch stop layer

Kim (763) discloses a method for forming a semiconductor device comprises the step of forming an etch stop layer of SiN, aluminum oxide (col 4, lines 60-65)

One skilled in the art at the time the invention was made would have found it obvious to modify Yang method by forming an aluminum oxide etch stop layer as per Kim (763) because Kim teaches that by using an aluminum oxide or a SiN layer as the auxiliary etch stop layer, the extent of dry etching can be more delicately controlled (col 4, lines 65-67)

Yang also fails to specifically disclose that the flow rate of the carbon oxide is greater than about 80 sccm

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Kim (293) discloses a method for etching a trench comprises a step of using a mixture of fluorocarbon and carbon oxide (100-400 sccm/flow rate greater than 80 sccm) (col 8, lines 55-65; Table 1)

One skilled in the art at the time the invention was made would have found it obvious to modify Yang method by using an etching mixture of fluorocarbon and carbon oxide having the flow rate as per Kim (293) because Kim discloses that it is beneficial to use an increased amount of CO as the additive gas ( col 3, lines 20-23) and the use of CO provides better selectivity for etching the dielectric material (col 8, lines 30-34)

The limitations of claims 2-4, 8-9 have been discussed above

Regarding claim 10, Yang discloses forming a semiconductor device by etching the via hole (col 5, lines 1-2)

3. Claims 11-14, 18-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yang et al (US 6,162,583) in view of view of Kim et al (US 6,500,763) and further in view of Kim et al (US 6,686,293)

Yang discloses a method for making intermetal dielectric on semiconductor device.

The method comprises the steps of:

providing a semiconductor devices over a substrate 12 (fig. 6)

providing a dielectric layer 20 over the semiconductor devices, the layer 20 having an etch stop layer 18 located thereunder (col 5, lines 55-65; fig. 6)

etching an opening in the layer 20 using an etchant comprising a carbon oxide,

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CF<sub>4</sub>/fluorocarbon, oxygen/an etch rate modulator and an inert carrier gas (col 4, lines 4-10), the etchant does not etch layer 18 (fig. 6), which reads on the etchant is selective to the layer 18/etch stop layer

making electrical contact to the devices through the opening (col 6, lines 45-50)

Unlike the instant claimed inventions as per claims 11, 20, Yang fails to expressly disclose using an aluminum oxide etch stop layer

Kim (763) discloses a method for forming a semiconductor device comprises the step of forming an etch stop layer of SiN, aluminum oxide (col 4, lines 60-65)

One skilled in the art at the time the invention was made would have found it obvious to modify Yang method by forming an aluminum oxide etch stop layer as per Kim (763) because Kim teaches that by using an aluminum oxide or a SiN layer as the auxiliary etch stop layer, the extent of dry etching can be more delicately controlled (col 4, lines 65-67)

Yang also fails to specifically disclose that the flow rate of the carbon oxide is greater than about 80 sccm

Kim (293) discloses a method for etching a trench comprises a step of using a mixture of fluorocarbon and carbon oxide (100-400 sccm/flow rate greater than 80 sccm) (col 8, lines 55-65; Table 1)

One skilled in the art at the time the invention was made would have found it obvious to modify Yang method by using an etching mixture of fluorocarbon and carbon oxide having the flow rate as per Kim (293) because Kim discloses that it is beneficial to use

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an increased amount of CO as the additive gas ( col 3, lines 20-23) and the use of CO provides better selectivity for etching the dielectric material (col 8, lines 30-34)

The limitations of claims 12-14, 18 have been discussed above

4. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fitch et al (US 5,324,683) in view of view of Kim et al (US 6,500,763) and further in view of Kim et al (6,686,293)

Fitch discloses a method for forming a semiconductor structure. The method comprises the steps of:

providing a substrate having an etch stop layer located thereunder (col 11, lines 20-23)

etching an opening in the substrate using an etchant comprising a carbon oxide, CF<sub>4</sub>/fluorocarbon, nitrogen/an etch rate modulator and an inert carrier gas (col 9, lines 5-27), the etchant does not etch layer 38 (fig. 22), which reads on the etchant is selective to the layer 18/etch stop layer

Unlike the instant claimed invention as per claim 7, Fitch fails to expressly disclose using an aluminum oxide etch stop layer

Kim (763) discloses a method for forming a semiconductor device comprises the step of forming an etch stop layer of SiN, aluminum oxide (col 4, lines 60-65)

One skilled in the art at the time the invention was made would have found it obvious to modify Fitch method by forming an aluminum oxide etch stop layer as per Kim (763) because Kim teaches that by using an aluminum oxide or a SiN layer as the auxiliary

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etch stop layer, the extent of dry etching can be more delicately controlled (col 4, lines 65-67)

Fitch also fails to specifically disclose that the flow rate of the carbon oxide is greater than about 80 sccm

Kim (293) discloses a method for etching a trench comprises a step of using a mixture of fluorocarbon and carbon oxide (100-400 sccm/flow rate greater than 80 sccm) (col 8, lines 55-65; Table 1)

One skilled in the art at the time the invention was made would have found it obvious to modify Fitch method by using an etching mixture of fluorocarbon and carbon oxide having the flow rate as per Kim (293) because Kim discloses that it is beneficial to use an increased amount of CO as the additive gas (col 3, lines 20-23) and the use of CO provides better selectivity for etching the dielectric material (col 8, lines 30-34)

5. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fitch et al (US 5,324,683) in view of view of Kim et al (US 6,500,763) and further in view of Kim et al (6,686,293)

Fitch discloses a method for forming a semiconductor structure. The method comprises the steps of:

providing semiconductor devices over a semiconductor substrate 12 (fig. 8)

providing a dielectric layer 30 over the semiconductor device, the dielectric layer having an etch stop layer located thereunder (col 11, lines 20-23)



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etching an opening in the substrate using an etchant comprising a carbon oxide, CF<sub>4</sub>/fluorocarbon, nitrogen/an etch rate modulator and an inert carrier gas (col 9, lines 5-27), the etchant does not etch layer 38 (fig. 22), which reads on the etchant is selective to the layer 18/etch stop layer

making electrical contact to the devices through the opening (col 13, lines 51-53)

Unlike the instant claimed invention as per claim 17, Fitch fails to expressly disclose using an aluminum oxide etch stop layer

Kim (763) discloses a method for forming a semiconductor device comprises the step of forming an etch stop layer of SiN, aluminum oxide (col 4, lines 60-65)

One skilled in the art at the time the invention was made would have found it obvious to modify Fitch method by forming an aluminum oxide etch stop layer as per Kim (763) because Kim teaches that by using an aluminum oxide or a SiN layer as the auxiliary etch stop layer, the extent of dry etching can be more delicately controlled (col 4, lines 65-67)

Fitch also fails to specifically disclose that the flow rate of the carbon oxide is greater than about 80 sccm

Kim (293) discloses a method for etching a trench comprises a step of using a mixture of fluorocarbon and carbon oxide (100-400 sccm/flow rate greater than 80 sccm) (col 8, lines 55-65; Table 1)

One skilled in the art at the time the invention was made would have found it obvious to modify Fitch method by using an etching mixture of fluorocarbon and carbon oxide having the flow rate as per Kim (293) because Kim discloses that it is beneficial to use

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an increased amount of CO as the additive gas ( col 3, lines 20-23), the use of CO provides better selectivity for etching the dielectric material (col 8, lines 30-34)

6. Claims 5, 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yang et al (US 6,162, 583) in view of Kim et al (US 6,500,763) and Kim et al (US 6,686,293 ) and further in view of Tsuchiya (US 2003/0127422A1 )

Yang as modified by Kim (763) and Kim (293) has been described above. Unlike the instant claimed inventions as per claims 5,15, Yang, Kim (763) and Kim (293) fail to disclose that the ratio of fluorocarbon to oxygen/etch rate modulator is at least 2:1

Tsuchiya discloses a method for high selectivity etching comprises the step of using an etching gas mixture having a the ratio of fluorocarbon to oxygen/etch rate modulator of 2:1 (col 3, paragraph 0037)

Hence, one skilled in the art at the time the invention was made would have found it obvious to modify Yang, Kim and Kim (293) by using an etching gas mixture having a ratio of fluorocarbon to oxygen of 2:1 as per Tsuchiya because Tsuchiya discloses that the fluorocarbon/oxygen is more important in the process and the preferred FC/O<sub>2</sub> is from 2:1 to 3:1 (col 3, paragraph 0037)

#### ***Allowable Subject Matter***

7. Claims 6, 16 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

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***Conclusion***

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 571 272 1471. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571 272 1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



LV

November 21, 2006